National Transportation Career Pathways Initiative

CROSS-DISCIPLINARY RESEARCH SUMMARY

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CROSS-DISCIPLINARY SUMMARY

Cross-Disciplinary Summary

INTRODUCTION

Shared here are the important cross-disciplinary highlights, observations, and recommendations regarding the state of the transportation industry, the characterization of its workforce, and the directives of this career pathway initiative. Excised from the complete Year One Report presented to FHWA in February of 2018, these "lessons learned" present a reduction of the analysis performed by the NNTW during the first year of this research.

The NNTW Regional Centers have worked collaboratively with leaders from transportation, education, and workforce development, to establish a body of research that challenges traditional approaches to job classification, occupational forecasting, and career pathway development. Each of the five centers contributed strongly to the development of methodologies and solutions that present a better understanding of how the transportation sector is evolving, what skillsets its future workforce will require, and how to prepare that workforce for employment. Collectively, these research efforts have informed the development of career pathways that lead to priority occupational clusters within each of the five transportation disciplines—Planning, Operations, Environment, Engineering, and Safety, as presented in more detail within the report that follows.

STAKEHOLDER ENGAGEMENT

The NNTW had the opportunity to convene with disciplinary working group (DWG) advisories on at least four formal occasions over the last year, both to inform members of initiative progress and to elicit critical industry and academic feedback on issues still under review. These issues included the identification of occupational priorities, the validation of job competency models, and the advisement of experiential learning programs and innovative learning strategies. While these meetings were clearly vital to keeping members and their stakeholder networks well informed, separate one-on-one interviews were found to be the most effective way to broaden staff understanding of occupational details.

The idea of maintaining a broader, external network of stakeholders represents a significant resource in terms of recommendations and validation of initiative processes and out-

CROSS-DISCIPLINARY SUMMARY

comes. NNTW continues to expand its stakeholder network through DWG associations, industry presentations, and social-media, with the goal of establishing a robust base of national survey respondents and subject matter expertise. The Operations Team alone conducted several stakeholder discussions at recent professional meetings, including the Tennessee Section Institute of Transportation Engineers, the Traffic Club of Memphis, the World Trade Club, the Greater Memphis IT Council InnovateIT Conference, the Journal of Commerce Inland Distribution Conference, and the DBi Services Annual Symposium.

Similarly, the Safety Team recently partnered with the National Center for Rural Road Safety to survey impacts of transformational technologies on the safety workforce, and with the Montana DOT Traffic Safety Division to address formal funding mechanisms that would support Montana State University Civil Engineering programs to work on priority safety projects. In preparation of a major survey launch, the Engineering Team contacted over 1000 external stakeholders to capture workplace characterizations for its highway maintenance workforce.

Research efforts alone—much of which can be performed in a vacuum of well-connected tools, databases, and literature posts across the internet—allow for a detailed and data-rich analysis of workforce competencies and the workplace environment. But accessing real experiential understanding of these factors from committed project advisors who represent both the employment and preparation sides of workforce development, as well as validating research through a network of relevant stakeholders, brings meaningful breadth and depth to project outcomes not just in terms of perspective over the issues at hand, but also in the occasional realignment of thinking and methodologies so that both offer a better match for the operation and performance of the transportation sector.

TECHNOLOGY & WORKFORCE

Much like employees in other industries, the transportation workforce is susceptible to the influences of emerging transformational technologies. And though the promise of such technologies may be substantial in terms of increasing a system's operational economy, efficiency, and user safety and convenience, the future of workers within that system can sometimes be uncertain. These technologies have the potential to eliminate current occupations, create new ones, and dramatically affect which skills are most in-demand from industry employers, particularly 10 years into the future. To anticipate these affects in an

CROSS-DISCIPLINARY SUMMARY

effort to adapt workers—through updates to workforce pipelines and professional development programs—so that they stay competitive in a dynamically changing workplace, requires the continuous analysis of relevant sector data (i.e., industry technology and sector employment forecasts) and input from professional advisories, to identify which technologies may become disruptive and how that might impact an industry as a whole, while also its employment opportunities and workplace competencies more specifically.

For instance, research suggests that the continued evolution of connected and automated vehicles will present a considerable influence over the transportation industry as a whole, while most directly impacting the highway maintenance and operations professions specifically. With an increased presence of automation and connectivity, the human involvement in traditional operations occupations, such as commercial drivers, will likely see a decrease over time. And the maintenance of such new systems, particular roadways confounded by extreme weather conditions, will likely require workers to have new competencies to operate more intelligent vehicles—possibly remotely—and manage more complex decision-making scenarios in what is becoming a highly data-centric workplace.

In a similar example, the more frequent usage of robotics and unarmed aircraft systems can greatly reduce the direct labor required for highway maintenance activities, while also providing a notable increase in workplace safety, as highway workers perform roadway or bridge inspections and repairs without actually being present at the worksite. This transition would naturally result in a competency-demand shift from “able to perform hands-on maintenance tasks to “able to deploy and operate remote craft”. Such implications suggest that, for this workforce, competencies of the future will be more geared towards machine interfacing and maintenance than actual on-site roadway maintenance, though naturally “experience in roadway maintenance” would remain a requirement either way.

This overall increase in the reliance and incorporation of technology into transportation systems also contributes to the “Internet of Things” (IoT) phenomenon, which is an ever-increasing connectivity and communication ubiquity between devices. The growth of IoT provides ever greater opportunities for data gathering and the necessary implications of associated advancements in the management of “Big Data”. For the workplace, this suggests that both data collection and data management will become key skillsets to staying relevant/competitive, along with an ability to read, interpret, and use this available data.

CROSS-DISCIPLINARY SUMMARY

Finally, to precisely identify transformational technologies and their consequence on the workforce is a somewhat unachievable pursuit, particularly in a rapidly changing industry like transportation. There are no guarantees that forces impacting industry development today will still prevail or assert the same pressures tomorrow, making vigilance and diligence the best strategies to forecasting the workforce effects of such influences. And regardless of which technology becomes most impactful, research suggests two general conclusions: (1) technological deployment will require a corresponding skills adoption, and (2) the requirement for improved data handling and analysis will continue to grow.

A full summary of transformational technologies and their anticipated effects on the five disciplinary workforces is presented within a separate report.

LABOR MARKET ANALYSIS

Validating occupational priorities using strong, evidence-based labor market information (LMI) is a fundamental approach to investing in workforce development solutions. "*Leveraging labor market data, employer input, and engaging educational and workforce stakeholders are explicit strategies being utilized to create a skilled, diverse, and aligned workforce and should serve as an important guide to stakeholders engaged in training and development.*" And yet the capture and analysis of reliable LMI using currently available online resources, job-posting databases, and query tools, has proven challenging throughout this project, when trying to surface employment data that best characterizes the occupations within the five disciplines of this transportation workforce.

Conventional LMI resources, such as employment data and forecasting from the Bureau of Labor Statistics (BLS) or Burning Glass Technologies, and the index of industry and occupational identities maintained through the SOC, O*Net, and NAICS systems, together provide a complex look into a traditional job market with title-centric occupations, but are less helpful at characterizing emerging industries and their occupations and workforce competencies. Some well-known limitations of these systems include:

- BLS employment projections are based on historic data that doesn't take into account any recent changes in the job market or impending influences from transformative technologies.
- BLS only provides labor market Information for occupations identified with a 6-digit SOC top code. Interest in data for emerging jobs (not represented by an SOC) will not find relevant information.

CROSS-DISCIPLINARY SUMMARY

- The O*Net job classification system adds 2-digits of resolution to the 6-digit SOC system, however BLS does not recognize these distinctions, so all underlying job titles share the same labor market data.
- BLS projections are for a 10-year period but are published with a 12 to 24-month time lag.

In most modern organizations, fewer professionals are employed to assume a broader range of responsibilities, mostly due to technology making greater levels of capability accessible to a broader audience. This same technological accessibility is also responsible for the reduction of what would now be considered incidental staff positions. At one time, a "Manager" was responsible for the coordination of efforts of subordinate staffers, collectively working within a common department. Today, a "Manager" is often also responsible for project scheduling and budgeting, contracted services, asset management, resource deployment, stakeholder presentations and report generation, etc. While the title itself was once sufficient to represent its occupational responsibilities, today it is the list of underlying competencies that better define the occupation.

This realization allowed the NNTW to approach each transportation disciplines as a cluster of jobs that share fundamentally critical employment competencies, as a more definitive way of identifying occupations within this sector. This approach not only supports the characterization of new and emerging occupations, but also helps to more clearly document the pathways that lead to these job clusters in terms of their competency lattice.

Further, by focusing on which competencies are in high demand from industry employers, versus which job titles are most often listed, a more exact representation of disciplinary priorities emerges, particularly when addressing new competencies that are expected to result from the impacts of transformational technologies. To adequately forecast the future workforce needs of an industry sector undergoing disruptive and transformational change, the research must first start with a foundational understanding of what those transformative forces are, how they will impact the workforce, and when those effects will take place. A draft of such an effort is available as a separate report.

Another complication of LMI-driven analyses is the lag-time present when top-down policies or practices are put into place versus when the competencies needed to implement those policies are defined and appear within job postings. Some skills projected to be increasingly in demand have yet to show-up in job descriptions, either because employers

CROSS-DISCIPLINARY SUMMARY

do not expect applicants to have access to such knowledge/expertise or because employers are not yet emphasizing those skills in their performance metrics. This is a particular challenge for career pathway implementation within a field like transportation safety, where practices are not yet being cultivated by agencies in terms of recognizing, actively seeking, and promoting staff with known safety competencies.

As NNTW pursues the characterization of the transportation industry—its occupational job clusters and disciplinary priorities—by cataloging and analyzing its common and critical competency sets, the validation of each research outcome and observational assumption is strictly tied to industry accepted data models, employer demand, and broad stakeholder surveys. Providing traceable and repeatable data-driven workforce solutions—via best LMI practices and employment forecasts—is a critical component of engaging subsequent partnerships for the implementation of these career pathway solutions.

STATE OF PRACTICE

A significant wealth of research and discovery has advanced the understanding of each discipline's occupational state of practice, curricular pathways of study, and experiential learning programs. Key investigatory tools used by NNTW researchers included the Burning Glass Technologies Labor Insight analytics tool to mine their captive database of job employment postings. This is done not just to yield labor market validation of targeted occupations, but to develop a broader picture of disciplinary components that occupy these workforce areas, in terms of industry specific employment requirements for workforce. Factors captured, cataloged, and analyzed included job titles; education, training, and competency requirements; previous work experience; certifications; and salary ranges.

The compilation of multiple national listings reveals the occupational state of practice for these careers, and promote those competencies that represent a core set of expectations employers desire from their workforce. The alignment of these competencies will support the development of a comprehensive cross-disciplinary map that lays out the multiple pathway options available to students pursuing a transportation career, both in-discipline and across, as a function of the attainment of common skills and competencies.

A second and equally important effort has been to ascertain the curricular state of practice (academic pathways of study) that represent the educational backbone of these career ladders. Essentially documenting the state of education and training for pathway

CROSS-DISCIPLINARY SUMMARY

travelers within each discipline, these efforts provide a basis for highlighting the gaps in training and certification that existing programs present, falling short in terms of adequately preparing new entrants to each respective workforce.

EMPLOYMENT TRAINING

Transportation employers, particularly those in the public sector, rely on on-the-job training (OJT) to prepare hew-hires for their workplace responsibilities. Few 4-year academic programs incorporate experiential learning or job training programs into their career-oriented programs of study. With the rapid pace of technological advances and demand of employers for more interdisciplinary skillsets from employees, it is more important than ever to create opportunities for students to be immersed in "real world" projects and content in order to extend their learning experiences. And, with evolving areas such as transportation operations or environment where there is not a single, specific disciplinary program of study that prepares students for these career pathways, industry-driven projects, innovative and alternative apprenticeship models, internships, and other industry-academic partnerships are necessary to help students develop essential knowledge, skills, and abilities within the pre-employment realm.

And while research into transportation construction-related academic programs revealed that some experiential learning and job training was incorporated into their programs of study, this is an outlier. Industry can and should utilize these training opportunities when present—and create them where missing, to integrate more current and in-demand content into these degree programs. Civil Engineering programs and ABET accreditation requirements for these degree programs provide a good case study, as accreditation criteria emphasize breadth of knowledge over specialization. As a rule, employers cannot expect that Civil Engineering Under Graduates will emerge with transportation-specific specialized skillsets or knowledge. Industry involvement in shaping experiential learning opportunities can act as an important driver to enabling the integration of more specialized content areas into degree programs. This is seen as a seriously underutilized resource.

Further, the lack of job training can also compound issues with attracting students to particular transportation careers, such as transportation operations, where students may encounter little relevant content related to the discipline in their course of study. This re-

CROSS-DISCIPLINARY SUMMARY

sults in students having poor understanding of career opportunities and limited contextual training relevant to the discipline. Underrepresented students may be disproportionately affected by this lack of pre-employment training, as many of these students leave academic programs or career paths because of lack of confidence or identity with the particular career field. Apprenticeships, internships, and other experiential learning models are demonstrated to be effective for addressing these issues. Because many transportation occupations have significant gender imbalance and low numbers of workers from ethnic minorities, there is a need to consider an approach at this stage in the pipeline to combat diversity issues.

With academic programs already stressed to cover required content, particularly to meet accreditation requirements, a different approach is needed to address pre-employment training challenges. There is a need for much greater collaboration across academia and industry than ever before in order to address transportation workforce challenges and to adequately prepare students for careers of the future. Thus, adopting a comprehensive strategy for integrating experiential learning into 4-year academic programs may lead to greater preparedness of students for the workplace and workforce, increased awareness and interest in specific transportation occupations, and improved diversity outcomes.

BARRIERS & RECOMMENTATIONS

One key barrier to implementing new programmatic material, whether curricular changes in response to skills gaps or career pathways in response to industry demand, is that in most postsecondary institutions, programs of study are contained within traditional academic silos. Further, academic programs for many priority occupations are constrained by program hour limitations and accreditation demands. As the need for more interdisciplinary education and cross-cutting skills increases, institutions will need to transform the way postsecondary education takes place in order to appropriately prepare students for the workforce of the future.

Better development of career pathways and connections between two and four-year institutions are also needed. For instance, if a student wants to pursue an engineering degree, accreditation challenges currently limit opportunities to create two-year engineering programs—resulting in relevant certifications—that can transfer to four-year institutions.

CROSS-DISCIPLINARY SUMMARY

Another barrier is that of misperceptions about careers in a discipline like transportation operations, and perceptions of technical careers in general, can limit the pipeline for some priority occupations (i.e., diesel mechanics, ITS technicians, traffic signal technicians, commercial drivers). This reflects a larger crisis in our country of undervaluing technical occupations and workers. It is essential to change the conversation around technical occupations so that more students consider these options.

A final insight is that better coordination and communication across the transportation industry is needed so that students are aware of the breadth of opportunities in the industry as a whole, rather than just within a particular transportation mode. This will also provide broader recruitment options for employers with recognition of non-traditional pathways that may provide appropriate background for particular occupations. Addressing these challenges will require concerted effort, significant time, and investment to ensure appropriate interventions and programs are developed through collaborative approaches.

Interdisciplinary certificates, at both the undergraduate and graduate level, may be one approach to addressing the challenge of academic silos in the short term. Non-traditional approaches to education must also be explored, including the role of apprenticeships and technical certifications/degrees as experience of value in four-year programs.

An important recommendation for success in addressing any of these barriers is that the focus cannot be limited to postsecondary institutions. By the time students reach postsecondary training and education, it is often too late; students may find themselves without the academic preparation to enter STEM fields requiring four-year degrees.

Additionally, attracting students to a particular profession needs to begin in K-12, as students begin developing perceptions of careers, identifying with gender stereotypes, and closing doors as early as elementary school. Further, parents are a key influencer in a student's choice of postsecondary path. Practitioners must also change the conversation with parents about "success" and the numerous paths for pursuing it, if we are to make any significant progress in raising the profile of, and respect for, technical careers.

CROSS-DISCIPLINARY SUMMARY

Most importantly, effective strategies for transportation workforce development must be collaborative. The right agencies, people, modes, and industries must be at the table to ensure that varied and wide-ranging perspectives are included and comprehensive solutions are developed.

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